

Commonwealth Edison Company's Quarterly Smart Grid Test Bed Report

November 14, 2014

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Introduction

This report summarizes the test bed activities, customers, discoveries, and other information deemed mutually relevant from July 1, 2014, through September 30, 2014 as described in subsection (i) of Section 16-108.8 of the Public Utilities Act (“Act”).

Active Test Bed Demonstration Projects

Sentient Energy

ComEd completed installation of nine overhead line monitoring devices associated with the Sentient Energy Test Bed demonstration project during the first quarter of 2014 to demonstrate voltage and current sensing capabilities, including fault current indication. These devices include cellular radios to wirelessly communicate information back to Sentient and ComEd. Since that time, Sentient has been collecting data from the devices and providing information to ComEd, such as line voltage and current, as well as event notification. The following screen shots illustrate the types of information ComEd is able to retrieve from the devices via the Sentient cloud software interface.



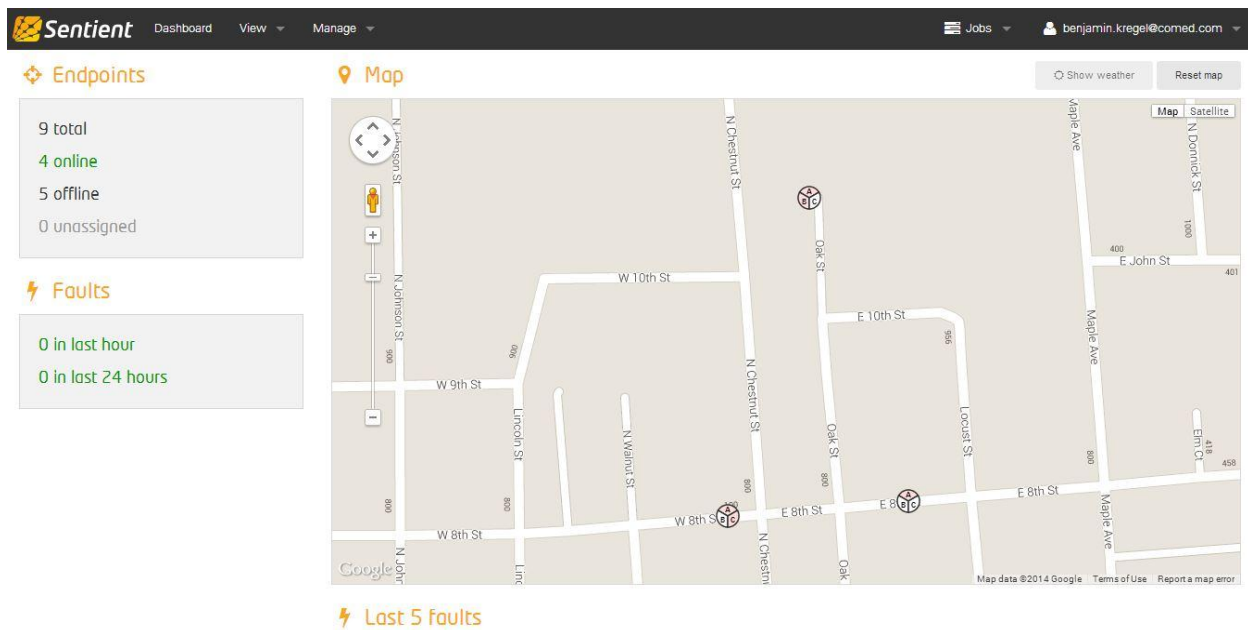


Figure 1: Map of device installation locations (3 devices per location)

Sentient Dashboard				
cFCI				
FILTER: High temperature High RMS current cFCI fixed trip cFCI percent change trip cFCI dl/dt trip cFCI loss of source				
Timestamp	Endpoint	Detector	Value	
06-14-2014 06:03:43 CDT	S395_ALR7029 (west) Phase B	High RMS current	506 A	
06-14-2014 06:03:43 CDT	S395_ALR7029 (west) Phase B	High RMS current	663 A	
06-14-2014 06:03:41 CDT	S395_ALR7029 (west) Phase B	High RMS current	508 A	
06-14-2014 06:03:41 CDT	S395_ALR7029 (west) Phase B	High RMS current	2019 A	
05-12-2014 21:52:36 CDT	S395_ALR7429 (north) Phase A	High RMS current	502 A	
05-12-2014 21:52:36 CDT	S395_ALR7429 (north) Phase A	High RMS current	553 A	
05-12-2014 21:52:36 CDT	S395_ALR7429 (north) Phase A	cFCI dl/dt trip	519 A	

Figure 2: Event Notifications



Figure 3: Per-Phase Current Profiles

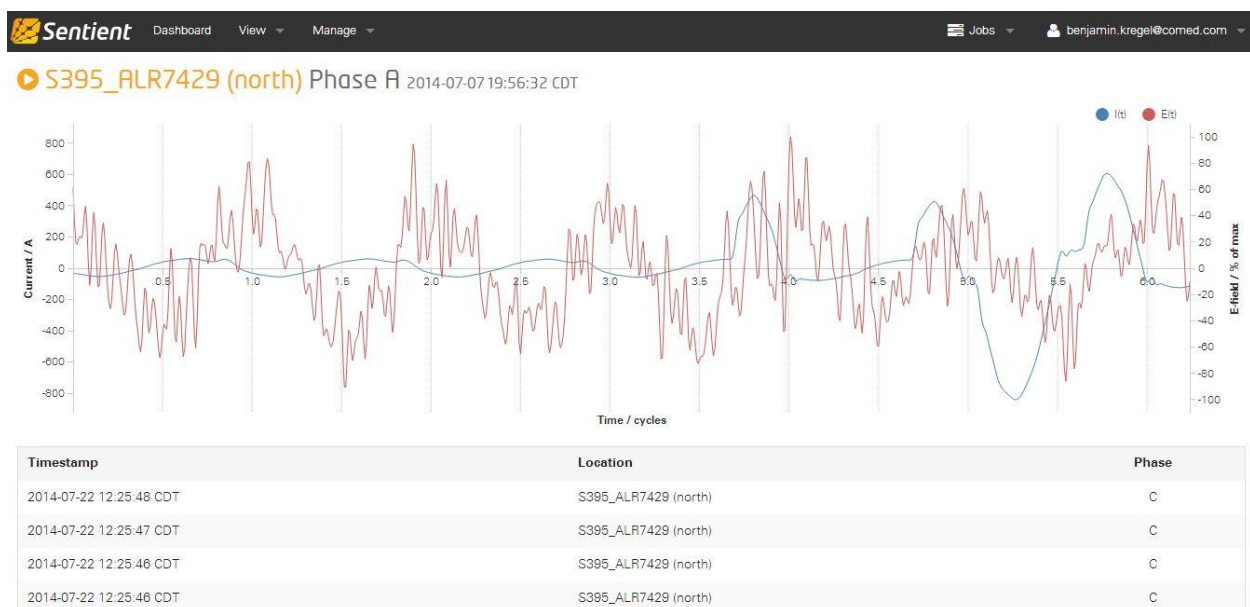


Figure 4: Single-Phase Current Waveform

As Figure 1 illustrates, Sentient had experienced issues with some of the cellular modems in the devices. These devices have been replaced and the new devices have been communicating as designed. Sentient had previously communicated their intent to develop a range extender (repeater) to extend the reach of the Silver Spring network to

Sentient devices. However, they have since decided to discontinue development of the range extender.

Overall, the demonstration has been valuable and fit the intended purpose of the Smart Grid Test Bed. Sentient was able to use experience gained in the Test Bed to make improvements to its product, enhancing its future usability in smart grid applications.

ComEd also benefitted from the demonstration by better understating characteristics of the equipment, and new ways in which technologies may need to interface with the smart grid.

GlidePath, LLC




Additionally during the first quarter of 2014, ComEd received and approved one new Test Bed Application from GlidePath Power, LLC. GlidePath is currently developing three 20MW battery storage facilities within the ComEd footprint of PJM. These facilities are intended to participate in the PJM frequency regulation market and will be located in McHenry, West Chicago, and Joliet, respectively. Construction is projected to be complete in 2015. Along with participating in the PJM regulation market, GlidePath wishes to demonstrate various grid support capabilities in ComEd's Test Bed, such as:

- Distributed fast frequency control
- Smart inverter functionality and capability to limit impacts of the battery facilities on grid equipment (e.g., substations)
- Distributed dynamic volt/VAR support, and how this can co-exist with the frequency control noted above

ComEd is developing a detailed scope of work and project agreement based on the grid support capabilities listed above.

NoteVault

Most recently, ComEd received a Test Bed application from NoteVault, who has developed a reporting system that enables field personnel to capture field notes via voice, and to attach pictures/video using a smart phone, tablet or other mobile device. Each note is then transcribed and automatically emailed, along with photos, as a PDF report to appropriate personnel. NoteVault's "cloud" based solution enables the "boots on the ground" to capture detail from a project site in

<h1>NOTE</h1>  <h1>VAULT</h1>					
Daily Construction Report					
Date	Project		Weather		
Friday September 26, 2014	Sample Daily Construction Report		TIME	TEMP	DETAILS
	630 N. Harbor	San Diego, CA 92101	03:50AM **	71.9°	Humidity: 73, Wind: 3 mph Cloudy
	10th & D	Timesone: America/Los_Angeles	11:11AM *	77.9°	Humidity: 60, Wind: 10 mph Partly Cloudy
			04:50PM *	76.9°	Humidity: 64, Wind: 9 mph Cloudy
			* Yahoo! Weather (http://weather.yahoo.com)		
Labor					
Name	Trade	Classification	Oty	Notes	
Harrison Construction	Mechanical	Superintendent			
DierCreek Co.	Site Construction	Crew	10	West parking lot,	
Total:				11	
Equipment					
Name	Owner	Oty	Status	Notes	
130 Backhoe	DierCreek Co.	2	Working	Loaded and unloaded.	
General Comments					
TIME STOP, 03:50PM RECORDED BY JOEY ZARATE			[Letting: 32.MET175, 17.196638]		
The building inspection came by and signed off of the huge earthquake in the East wall westrooms. We mentioned that we need to provide the handprint signage according to the new ordinance. I sent an RFI to the architect to provide updated sign specifications. This could cause a delay.					
					
Change Requests					
TIME STOP, 10:11AM RECORDED BY DERICK DOWNS			[Letting: 32.MET1384, 17.176438]		
A request has been made by the DierCreek Construction Group with concurrence by Elvix Electricians to change the sanitary sewer at Greenview Road from 34" AC Pipe Sewer Diameter 3000 CFS - Jacked, to open cut 34" AC Pipe Sewer. I'm documenting this in the daily report so that we know the change order will be required.					

Printed By NoteVault

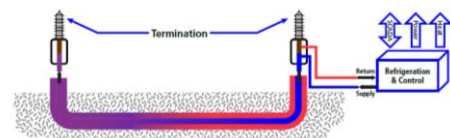
NoteVault Inc. Demo Account | Sample Daily Construction Report | Thursday, September 18th 2014 | Page 1 of 1

real-time. ComEd has scheduled an initial discussion with NoteVault to better understand the capabilities and applications for its technology; and to determine the potential scope of a Test Bed demonstration.

Other Technology Demonstrations

Superconductor Development

ComEd and American Superconductor (AMSC) recently agreed to partner with the Department of Homeland Security (DHS) in its Resilient Electric Grid Program. Developing plans to deploy high temperature superconductor cable in Chicago's central business district (CBD). This DHS program is designed to provide protection against the catastrophic effects resulting from the loss of critical substation facilities by allowing the sharing of capacity of nearby substations that cannot typically be accomplished through conventional means.



The superconductor cable would interconnect five key electrical substations in the city and provide enhanced security and redundancy to critical infrastructure. Given the significant level of external funding and the size and scale of the project, one of the project goals is to significantly reduce the cost of manufacturing the superconductor cables.



In addition to providing reliable power and increased security, this installation of more than three miles of superconductor cable would create the most extensive superconductor project of this nature in the world. ComEd's transformation of our business relies heavily on technology and innovation. In this era of increasingly intense weather events and other potential catastrophic occurrences, this project will not only support the City of Chicago but can serve as a model to enable widespread implementation of the superconductor technology nationally and globally. ComEd and AMSC are conducting a feasibility study over the next 6-9 months to develop a deployment plan.

Fleet Demonstration of Electric Vehicles

Through a partnership with the Electric Power Research Institute (EPRI) funded by the U.S. Department of Energy, ComEd is deploying 35 plug-in hybrid electric vehicles (PHEVs) in its vehicle fleet. These PHEVs will range from pickup trucks and full-size vans, to large utility vehicles such as bucket trucks, digger-derricks and underground construction vehicles. The primary objective of the demonstration is to better understand the costs, benefits and impacts of operating PHEVs in a large utility fleet application. Each of the vehicles is equipped with data loggers that will capture information such as driving patterns, charging cycles, and petroleum fuel vs. electric usage. This demonstration will provide ComEd with valuable insight into the operation of PHEVs in a variety of vehicle



platforms and duty cycles, as well as opportunities to improve the benefits of electric driving as the Company continues to expand use of EVs in its vehicle fleet.

Fuel Cell Demonstration

ComEd is working with Toshiba to showcase the first implementation of a Toshiba fuel cell in the United States.

The initial Toshiba Ene-Farm unit, originally designed for residential applications in Japan, is being planned for installation at Brookfield Zoo, to provide power and heated



water to the Zoo's Stingray Bay exhibit. The demonstration will help ComEd and Toshiba to better understand the operation and applicability of the technology in the U.S., and the exhibit will serve to educate the public on fuel cell technology. Toshiba is presently evaluating the necessary steps to certify



their fuel cell for use in the U.S., including certification by Underwriters Laboratories.

Community Energy Storage for Frequency Regulation

S&C Electric, located on Chicago's north side, has developed a demonstration that utilizes distribution-connected community energy storage (CES) for frequency regulation.

The objective of the demonstration is

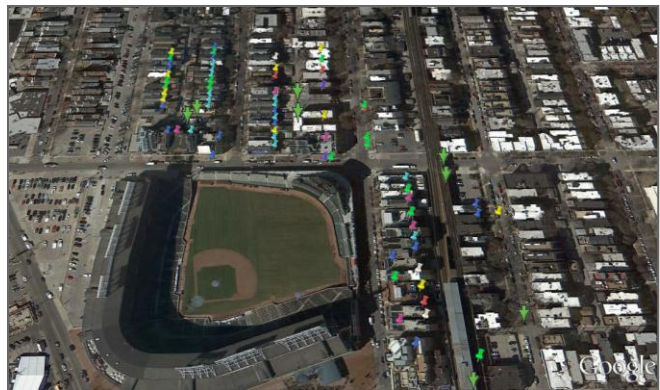


to show the many uses for distribution-connected energy storage, as well as how stored energy can participate in the PJM frequency regulation market.

The demonstration includes six 25kVA CES units, each with its own 25kWh battery for a total combined output of 150 kVA/150 kWh. When given a command from PJM (the Reg D signal) the CES units automatically discharge into the grid - providing the level of power requested by PJM - or absorb excess power from the grid while charging the batteries. To help visualize the Reg D activity, the CES units in the demo have been equipped with a monitor that displays the current activity real-time, as well as LED lights that communicate the status of the regulation command. RED indicates the units have been commanded to discharge, while GREEN indicates charging. If the LED lights are WHITE, the system is not being commanded.

WrigleyVille AMI Voltage Analysis and Transformer Monitoring

In 2010 and 2011, ComEd experienced cases of low-voltage and transformer overloading in the neighborhood surrounding Wrigley Field. These events were particularly impactful to the Wrigley RoofTops – multi-story



residential buildings across the street from the ball park that have been renovated to add rooftop seating to watch Chicago Cubs games, while offering food and beverage services.

With the night games at Wrigley field and the RoofTop venues, load factor and system loading profiles are not typical of a residential area.

ComEd's Regional Engineering was able to address the issues and none have been reported since that time, however with the deployment of Smart Meters, the opportunity arose to utilize voltage data from these meters to both validate effectiveness of the solutions employed, and monitor this high-profile area on a real-time basis to predict potential future issues.

To conduct the study, ComEd accelerated deployment of the Silver Springs network in the area - 269 Smart Meters on accounts associated with impacted transformers - and began gathering time-sequenced load and voltage data.

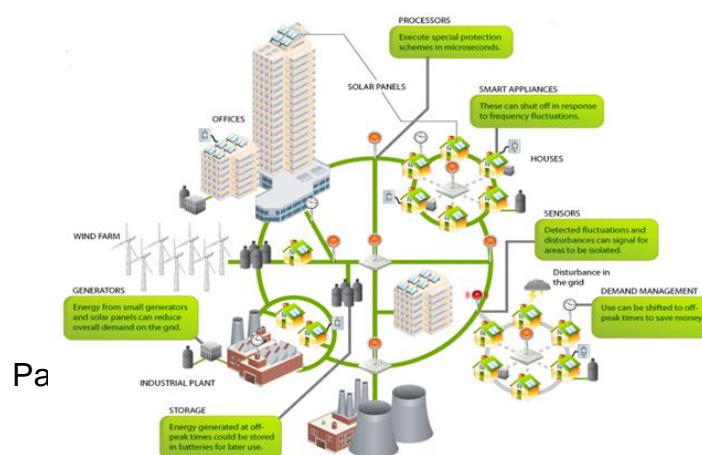
ComEd has also been demonstrating the Grid Sense TransformerIQ monitoring device with Silver Springs Network communications capability on local transformers in the Wrigleyville neighborhood.



The data from the TransformerIQ is fully integrated into ComEd's PI Historian system, which is used to collect and display SCADA data. As ComEd deploys more smart meters, we will have an enhanced ability to see very granular load and voltage information and aggregate that information to the transformer level. Thus, it is projected that use of devices such as TransformerIQ would be limited to niche situations such as monitoring 3:1 transformers and network transformers, or to investigate very complex theft of service situations.

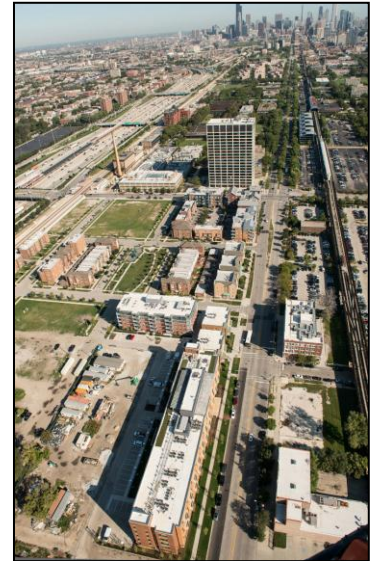
Microgrid Development

In support of President Obama's Climate Action Plan and the Administration's commitment to



improve national power grid resiliency, the Energy Department recently announced more than \$8 million for microgrid projects to help cities and towns better prepare for extreme weather events and other potential electricity disruptions.

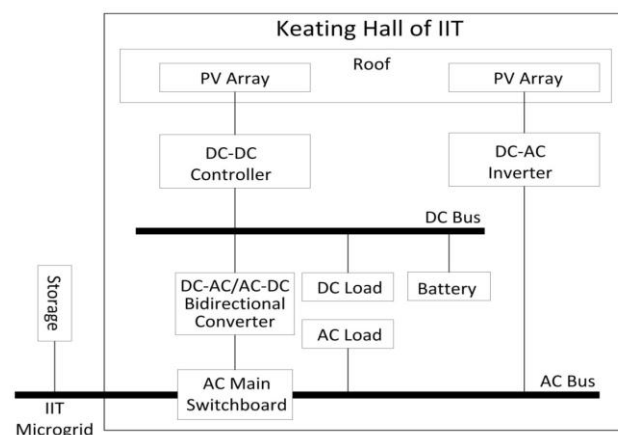
ComEd was selected by the U.S. Department of Energy (DOE) to receive a \$1.2 million grant to build a master controller that could drive the operations of clusters of microgrids. ComEd assembled a group of leading science and technology partners for the DOE proposal including Alstom Grid, Argonne National Laboratory, Illinois Institute of Technology, Microsoft, OSIsoft, Quanta Technologies, S&C Electric, Schneider Electric and University of Denver.



ComEd is evaluating Chicago's Bronzeville neighborhood, adjacent to IIT, to demonstrate the clustered microgrid controller. ComEd's microgrid concept includes a diverse mix of facilities and critical loads, including police and fire department headquarters, major transportation infrastructure, healthcare facilities, and private residences.

Nanogrids: AC/DC Hybrid Systems

ComEd, Illinois Institute of Technology (IIT), Argonne National lab, Department of Energy (DOE), Emerge Alliance, and Starline DC Solutions are partnering up to develop a hybrid nanogrid for IIT's

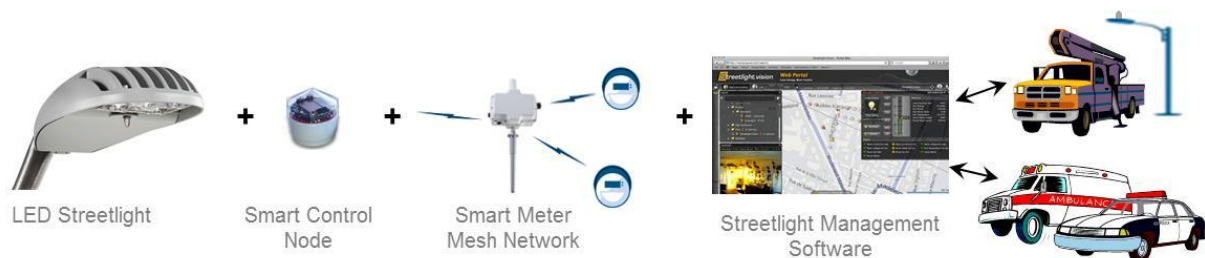


Keating Hall. This effort is funded through a U.S. DOE grant. Nanogrids are a sub-category of microgrids, generally supplying power to a single building or load, and typically include both alternating current (AC) and direct current (DC) components. As the name nanogrid suggest they are generally much smaller than conventional microgrids. DC loads, such as data centers and LED lighting, together with proliferation of DC-based distributed generation and energy storage are likely to reshape power distribution. The Keating Hall nanogrid will incorporate PV generation, LED lighting, and power conversion equipment. The main drivers for hybrid nanogrid development are (1) PV assets installed on the rooftop, (2) reduced conversion losses, and (3) LED lighting solutions for more efficient and controllable lighting for the building. The overall goal of the project is to learn about integrating the AC and DC systems for a building-scale nanogrid solution. The learnings from this small demonstration could enable ComEd to apply these technologies to new microgrid and nanogrid developments

Smart LED Streetlights

ComEd is evaluating opportunities to offer smart LED streetlight service to the communities we serve. The solution would leverage the wireless mesh communications network that is currently being built as part of our smart meter deployment

The ubiquitous nature of the network allows us to reach all areas of the ComEd territory, extracting additional value from the smart grid investments ComEd is already making.



A smart streetlight control node would be installed on each light fixture. The control node include the same wireless radios in ComEd's smart meters, allowing it to communicate on the same mesh radio network as our smart meters. Each control node also includes revenue grade metrology, enabling improved accounting for energy usage, and potential further energy reductions through functions such as streetlight dimming.

The web-based streetlight management software enables the creation of portals for various users with specific functionality sets (e.g., emergency responders, maintenance personnel, event management). Streetlights can be controlled on via pre-set schedules or on an ad-hoc basis, either individually or as groups.

A smart LED streetlight solution leveraging ComEd's smart meter communications network offer a variety of benefits. The highly-efficient, longer-lasting LED fixtures with remote control & monitoring significantly increase energy savings and reduce maintenance costs, while improving security and safety through fewer light failures and greater resiliency to damage. Also, the web portals for police and emergency responders enable lights to be controlled on demand in the event of an emergency. The network itself creates a platform for a wide array of potential future sensors (e.g., weather, traffic, air quality); and measurement devices such as water meters.

Smart Grid Collaboration

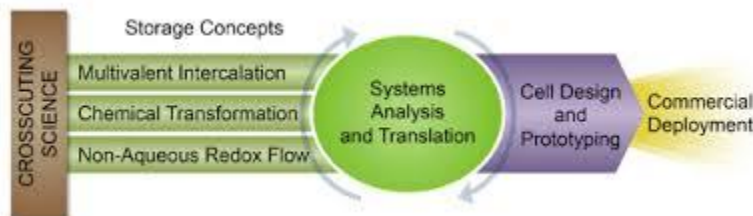
JCESR

ComEd is participating in the Joint Center for Energy Storage Research (JCESR). Led by



Argonne National Laboratory, the focus of JCESR is to make significant improvements in capabilities of battery storage while reducing costs. ComEd is represented on the JCESR Venture Advisory Council.

In its first year, JCESR completed foundational research in all four of its target areas: discovery

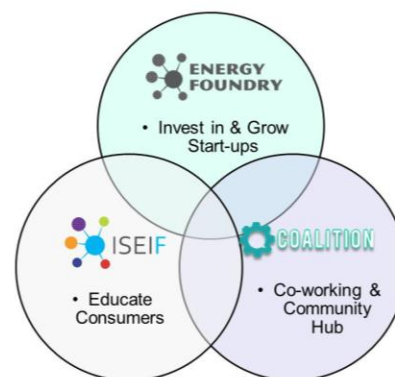


science, battery design, research prototyping, and manufacturing collaboration. Such research includes:

- Use of the Electrochemical Discovery Lab to discover that trace amounts of water control the speed and outcome of the electrochemical reactions that release energy in the lithium-oxygen discharge reaction.
- Established minimum standards of materials properties needed to achieve battery systems with factors of five higher performance and lower cost.
- Demonstrated an “infinite current collector” that increases flow battery capacity by a factor of five.
- Signed a Memorandum of Understanding with NASA Glenn Research Center for the development of next-generation batteries for future space missions.

Energy Foundry

ComEd continues to support the Energy Foundry in its mission to foster innovative new grid-related and energy-related products and services. ComEd's vice president of smart grid and engineering holds weekly office hours at the Foundry's Coalition Space in downtown Chicago to talk face-to-face with



entrepreneurs and provide the utility perspective as they develop new ideas. The pipeline continues to be robust, with over 220 applications to date, across a diverse range of business sectors and development stages such as gas, water, energy storage, transportation, generation, power electronics, building technology and infrastructure.

CSMART Laboratory at IIT

Built with the support of IIT, ComEd, Silver Spring Networks and West Monroe Partners, CSMART is one of the first of its kind to bring together academic, industry and utility experts to provide a fully-functional test environment for smart grid and smart city technology.



CSMART provides the platform to conduct a wide range of smart grid and smart city R&D analysis projects. Some of the initial, state-of-the-art demos include:



- Smart street lights operational testing – Intelligent and adaptive networked street lights can reduce operating and maintenance and energy costs by 75 percent

through LED lights that are controlled and connected by a network. The software helps provide scheduling, remote on/off and dimming features as well as outage detection notification for faster repairs to ensure the safety of citizens and the community. Smart street lighting networks can also establish a platform upon which additional smart city applications can be deployed.

- Distributed Energy Resource Management – ConnecttheGrid™ – cloud-based application that provides work-flow management and an online dashboard for utilities to manage distributed generation application approvals, including roof top solar, as well as providing asset tracking, reporting and forecasting.
- Data analytics and real time interactive dashboard - smart-grid communications networks are used to monitor operations and collect data from throughout IIT's electric microgrid in order to optimize electrical efficiency of the system and predict faults prior to their occurrence.

Smart Grid Exchange

Through the Smart Grid Exchange, ComEd is starting the process of co-designing the future of electricity with companies interested in developing smart grid-enabled products and services.

This includes enabling third parties to develop new products and services that run on the improvements to electric grid ComEd is making; working with select developers who bring demonstrated value to customers; and giving our customers a convenient portal from which they can learn about new and developing



energy products and services.

Programs already underway through the Smart Grid Exchange include:

- Student Innovation Contest – In May (2014),

ComEd launched its new “Student Innovation Contest”, which tasks college students with creating innovative smart meter related products, services or software



apps that will help empower low-income customers to use their home’s smart meter to manage their electric bill and save energy. Forty four (44) student and teams entered, and the top five formally presented their ideas to a panel of industry experts in October for a share of \$10,000.

- ComEd, in partnership with Silver Spring Networks (NYSE: SSNI) and Accenture, hosted its SmartGridExchange Forum, bringing together leading technology and innovation companies, including Oracle, Nest Labs, Home Depot, GE Energy, and the Energy Foundry, with other customer and stakeholder organizations, including the City of Chicago, Citizens Utility Board and Smart Grid Consumer Collaborative, to discuss how to leverage the smart grid to deliver increased value to consumers.